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Digital Transformation in the Restaurant Industry: Current Developments and Implications

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Abstract

Restaurants are an important area of the hospitality industry. This industry sector has not only experienced severe consequences of the recent lockdowns, but it has also seen the rise of digital technologies. As known from other industries, the digital transformation impacts products, processes and business models alike. Starting from the classical distinction of a restaurant's front- and back-of-the-house processes, this paper presents an overview on current developments in the restaurant industry and based on an analysis of current digital services, it derives some implications for future directions. Among the observations are that restaurants need to cover more touch points, provide more individualized offerings and strive for more automation as well as integration of their systems.

Keywords

Back-of-the-house; Digital services; Digital transformation; Digitalization; Front-of-the-house; Innovation; POS system; Restaurant industry

1. Changing Restaurant Industry

In recent years, the digital transformation has fundamentally changed numerous industries. Among the examples are media (news portals, streaming services), retailing (mail ordering and online groceries), tourism (online travel agencies, sharing platforms), and banking (online banking, smart payments). Similar changes may be observed in the hospitality sector, a part of the larger tourism industry that comprises the restaurant industry. Over the past years, this field has seen the rise of digital innovations, increased competition and, most recently, it has experienced the decisive event of the Corona pandemic. Due to lockdowns and other prevention measures, restaurants worldwide have had to encounter considerable losses in sales (Kim & Lee, 2020). Without being able to prepare adequately, low-contact services such as ordering, pick-up and delivery, have become their primary sources of revenue. At the same time, the forecasts for the post-pandemic future are positive with a growth rate of up to 28 percent compared to the 2019 period being expected for Germany in 2021 (Prognos, 2020).

However, it may be expected that the future world for restaurants will not resemble the situation before the pandemic (Milwood & Crick, 2021; Murphy, 2021). An important reason are the strong efforts in digitalization, where restaurants not only invested in digital resources, such as point-of-sale (PoS) devices, online ordering systems or e-commerce platforms, but also conceived new processes for pick-up or delivery as well as for low-contact interaction with their customers. In view of the widespread use of videoconferencing, e-commerce or other digital tools during the pandemic, customers are more ready than before to use digital means when visiting restaurants and competition has increased with many novel offerings, such as remote ordering or personalization to enhance customer experience. The potential of this change has been recognized before the pandemic and is visible in growing investments in start-up businesses worldwide (Rosenheim, 2019). Among the examples are Swiggy, a leading Indian online restaurant marketplace that received a $600 million funding, iFood, a Brazilian restaurant marketplace that gained a $590 million funding or DoorDash, a US food delivery service that received $535 million in funding. Now often referred to as "foodtech" to denote "the online food ordering and delivery ecosystem" (Raman, 2018, p. 131), this sector has attracted total investments of approximately €2.3 billion in Europe (Five Seasons Ventures, 2019) and has also seen the rise of delivery platforms such as Deliveroo or Delivery Hero (Li et al., 2020).

Like many buzzwords, foodtech is used heterogeneously and comprises the "use of disruptive digital technologies along the agri-food chain" (Renda, 2019, p. 171). This broader conceptualization includes the production and trading of food where wholesalers are also driving digital initiatives for restaurants. For example, Germany's Metro Group launched its Dish platform to connect restaurants more interactively with their customers by providing digital reservations, online menus, or digital shift schedules (Demen-Meier et al., 2017). Similar approaches may be observed with global food processing companies such as Switzerland's Nestlé. They not only apply digital technologies in their upstream supply chain towards the production facilities and the farmers, but also downstream towards the point of consumption, thus including restaurants (Spielman, 2021). With the diffusion of such offerings the question arises, how restaurants can leverage digitalization for post-pandemic times. Based on existing research in the hospitality sector, the following aims to shed some light on these developments by structuring current services in the restaurant market and by deriving strategic implications for restaurants.

2. Restaurant Processes and Systems

To understand how restaurants work, two concepts are helpful. On the one hand, restaurants are businesses where physical meals are prepared and served. In this respect, the supply chain concept is established to structure the processes that are

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associated with the flow of physical goods. They should be designed as smooth, efficient and reliable as possible across multiple parties involved. Supply chains link upstream suppliers of raw materials with manufacturers and ultimately with downstream actors like dealers and customers. In addition, various logistics service providers are involved to support the transport, storage and handling of tangible goods. On the other hand, restaurants are service businesses, which differ in important aspects from linear physical supply chains (Henning-Thurau, 2004): they often comprise a strong intangible component, they are hardly amenable to being stored and inherently rely on a close interaction between service suppliers and service consumers. This applies to the hospitality sector and to restaurants in particular where meals are typically prepared after interactions between restaurant staff and customers in the order process.

To structure service interactions in more detail, the service management literature (e.g., Sampson, 2012) distinguishes between processes that are visible to the customer (and thus require a direct involvement of the customer) and processes that are invisible to the customer (but nevertheless important for service provisioning). Depending on the side of the so-called line of visibility (see Figure 1), the literature refers to the processes as front- and back-office (e.g., McGill, 2008; Sampson, 2012), front- and backstage (e.g., Glushko & Tabas, 2009) or front- and back-of-the-house (e.g., Ng, 2010, Sachs et al., 2014). The latter distinction is established in the restaurant sector with front-of-the house (FoH) processes comprising all interactions with customers during a restaurant visit, such as waiting, seating, dining, as well as activities before or after the stay, such as the website presence, marketing interactions, food delivery as well as payment and reviews. Activities in the back-of-the house (BoH) area pertain to supply chain processes with food preparation and cooking as well as to administrative, sourcing and management processes (Cavusoglu, 2019; Sommerville, 2007)[1].

Although restaurants may be characterized with FoH and BoH processes, there are important differences. The restaurant industry consists of various segments that depend on food type, quality, atmosphere and price. For example, a locally-owned pizza-café and a national pizza chain serve the same purpose, but nevertheless feature different business models (see Auty, 1992, p. 336). In particular, this pertains to the technological resources with information technology (IT) being an important part. An analysis in 2010 clustered restaurants in casual (having table and bar service), quick-service (having limited service and pick-up) and family (table service and no bar) segments (Huberet al., 2010). They found the quick-service segment to be highly franchised and the casual-service as well as family-style restaurants to be mostly smaller and corporate owned. Not surprisingly, the study confirmed that "national chains have more financial resources to invest in systems development than independently owned restaurants" (Huber et al., 2010, p. 276). This led to more sophisticated BoH systems, in particular for operations and forecasting, while smaller businesses had rather general applications for sales tracking, word processing, book keeping and e-mail in place. It often meant using a simple electronic cash register and a generic personal computer that was connected to the internet.

The study from 2010 also pointed at a development that was observed in other industries. It pertains to integrated application systems that cover a broad array of functional areas within a company and have been referred to as enterprise resource planning (ERP) in the manufacturing sector or merchandise management systems in the retail sector. They became a competitive necessity in many industries and similar concepts may be found under the notion of PoS systems in the restaurant sector. These systems combine key FoH processes such as ordering, table assignment and payment with BoH processes such as inventory management, sourcing, labor scheduling and accounting (Cavusoglu, 2019; Ng, 2010; see Figure 1). The integrated nature is visible in cross-functional processes, where handheld devices might directly capture orders and forward them to the kitchen, which would use them for task scheduling as well as for planning the replenishment of ingredients. Similarly, customer relationship management (CRM) functionalities would store bills in a customer history support and use them for analytical purposes. Well-known PoS systems from Enfore, Lightspeed, Oracle Micros, Square, Toast, TouchBistro, Upserve, Vectron and others have spread among larger franchise chains for some time with numerous offerings having emerged for smaller restaurants more recently[2].

Regarding the adoption of PoS systems, it was confirmed that they are mainly present in larger (i.e., franchised) restaurants (Huber et al., 2010) and it was found that in the FoH area, these systems often interfered with the personal relationships to customers and faced the risk of being rejected by customers as well as employees (Christ-Brendemühl & Schaarschmidt, 2019). Among the requirements were the design of intuitive functionalities that could be easily handled even with a frequently changing workforce (Kreeger et al., 2017) and that technology should be in the background without creating emotional side effects, e.g., due to slow response times or complex entry procedures (Berezina et al., 2019; Murphy et al., 2019; Solnet et al., 2019). Regarding BoH processes, inefficiencies were reported when interacting with large wholesalers or suppliers: on the one hand electronic interfaces require configuration and testing, while (proprietary) portal solutions involve manual logins on the other. In particular smaller restaurants faced restrictions regarding technical skills since they lack dedicated IT administrators (Huber et al., 2010; Moreno & Tejada, 2019). This was often seen as a major constraint for innovations in the BoH as well as in the FoH areas. An example are internet presences where social media have been recognized as valuable to interact with customers, but the web presence of many, in particular the smaller, restaurants remained static and little interactive (Lepkowska-White & Parsons, 2019).

3. Innovation with Digital Services

During the past ten years, the digital transformation gained momentum with the convergence of several technological developments. This not only comprised the bundling of network technologies under the notion of triple or quadruple play, but in particular the confluence of social, mobile, analytics and cloud computing under the notion of SMAC. In addition, the more recent coming together of distributed ledger technologies (DLT, including blockchain technologies), artificial intelligence (AI), extended reality (XR) and quantum computing (QC) was captured under the notion of DARQ (Alt, 2021). These technological developments allowed for digitalization on a technological level, but increasingly comprised the application level with redesigned business processes and business models (Alt, 2018). They are embodied in digital services, which are application systems provided by service providers on third-party infrastructure (i.e., in the cloud) and are typically charged on a per-use basis instead of being licensed locally. For users, cloud solutions entail many advantages (e.g., Zysman & Kenney, 2018). In the present case, restaurant owners are relieved from purchasing and administrating an own system infrastructure. Instead they only need a network connection and the

[1] The generic supply chain processes in Figure 1 show the key processes from the Supply Chain Operation Reference Model (SCOR) and comprise the activities plan, source, make, deliver, enable and return (APICS, 2017).

[2] For overviews on available systems see Brophy (2020), Business.org (2021), James (2021), Pickard-Whitehead (2019), Porter (2020), and Vissers (2021).

appropriate client hardware, which is often universal in nature (i.e., standard tablets and handhelds instead of proprietary cash registers). An analysis of web resources[3] on digital services in the restaurant sector undertaken in March 2021 yielded a collection of services, which was clustered with an industry expert to 14 service areas (see Table 1).

It may be observed that digital services have emerged in many segments of the FoH and/or the BoH area. Besides the support of traditional PoS functionalities, such as ordering, payment and back-office processes, more specific services are present. For example, FoH services include social media presences, digital signage devices and reward programs as well as BoH services functionalities for accounting, the smart kitchen and restaurant management services in general. The overview also emphasizes that SMAC and DARQ technologies have become important enablers of digital services:

- Mobile devices such as smartphones and tablets are used by customers and restaurant staff alike. Being connected allows customers to digitally interact with the restaurant regardless of whether they are at the restaurant's premises or not and to determine which channel they prefer to access the restaurant's services (e.g., online/on-site ordering, self-service/assisted ordering).

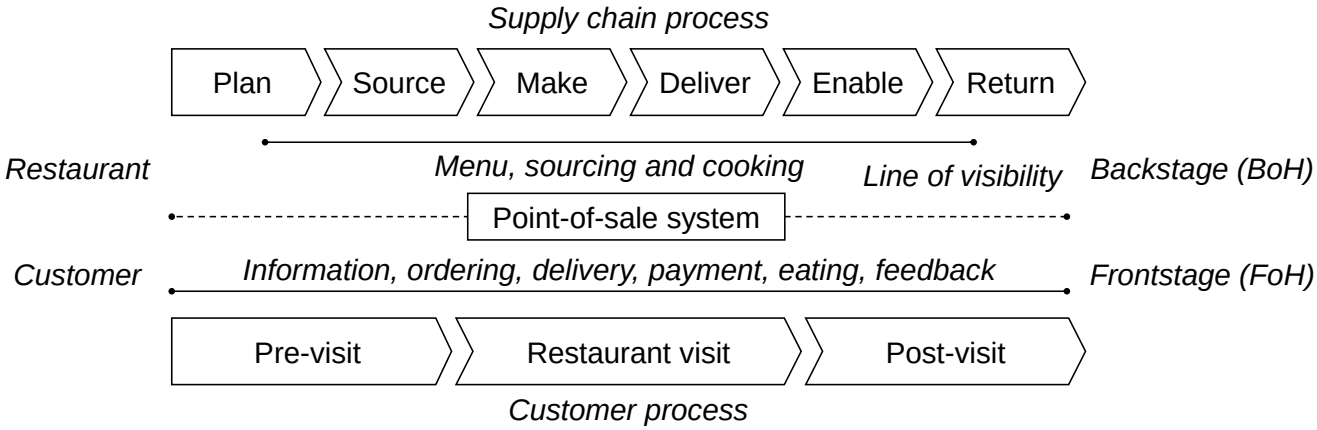

Fig. 1. Overview of restaurant processes

Table 1. Areas of digital services in the restaurant industry with examples

Service area	Description of service area and examples	Main coverage	
		FoH	BoH
Accounting and controlling	Services for accounts payable and receivable, the creation of tax reports, financial statements and cash flow analysis (e.g., Sourcery, Plate iq, Prognolite)		•
Comforting and entertainment	Services that contribute to "feeling good" in the restaurant, e.g., charging stations (e.g., Doblet), smart tables (e.g., Digital Touch, Kodisoft), guest Wi-Fi systems (e.g., Zenreach, Social Wave)	•	
Delivery	Services that provide digital platforms with coordination of the pick-up and delivery of meals (e.g., ChowNow, Delivery Hero, Deliveroo, Lieferando)	•	•
Digital signage	Services that provide menu and marketing information on specific devices, e.g., stand-up displays, interactive displays (e.g., Kuusoft, ScreenCloud)	•	
Food and beverage preparation	Services that aim at applying robotics in the kitchen, e.g., for the preparation of food components (e.g., BeeHex, Chowbotics, Innit, Moley, Nymble)		•
Hygiene	Services that monitor hygiene regulations and the planning and documentation of appropriate measures, e.g., cleaning scheduling and checklists (e.g., Check Cloud, Qualizy, Flowtify)		•
Information and marketing	Services that provide customers with general information prior and after the visit, e.g., campaigns and reward programs (e.g., Belly, Flipdish, Hostme, Plexure, Quandoo, Spendgo)	•	
Kitchen automation	Services for managing activities in the kitchen, e.g., ticketing systems, kitchen display systems, sourcing functions (see below; e.g., Limetray, TouchBistro)		•
Operational restaurant management	Services that support managers and employees in the daily process by analyzing service data (e.g., Doshii, Hostme, TouchBistro, Trakbar, Tiller)		•
Ordering	Services for (self) ordering in the restaurant, e.g., waitlists, table management, digital menus and payment (e.g., Bluecart, Divvoice, Hostme, Menu, Ordermentum, Paytronix Table Duck, Ziosk)	•	•
Payment and transaction	Services that support diverse means of digital payments, e.g., credit card, smartphone payments (e.g., FlyPay, Levelup, Square, Sum up)	•	•
Reservation and booking	Services for booking seats in the restaurant, e.g., online reservation platforms (e.g., Omnivore, Open Table, Quandoo, ReserveOut, Toreta) and digital waitlist management (e.g., Hostme, QLess, Seatris, Waitlist me)	•	
Sourcing and supply	Services for the procurement, e.g., vendor selection, order placement, tracking and tracing to origin (e.g., Foodnotify, Delicious Data, FTrace, IBM FoodTrust, Ordermentum, ripe.io, Sourcery, Choco, Katoo)		•
Staffing and employee education	Services for hiring and assigning staff based on seasonal needs (e.g., Adia, Shiftgig, TaskRabbit) and digital schooling for training new staff (e.g., Gastromatic, Schoox, Waitrainer)		•

[3] Based on Alday & Rosas (2019), Cavusoglu (2019), CBI (2017), Chick, Duffy, & Seligsohn (2020), Chochiang, Ung, & Bunsamna (2020), Cosgrove (2020), Demen Meier et al., (2017), Lewin (2020), Li et al., (2020), Murphy (2021), Paytronix (2020), Pilon (2018), and Rosenheim (2019).

In principle, they are in a position to obtain the same information and to access the same applications as the employees of the restaurant. Information asymmetries are reduced and many other potentials of digitalized processes (e.g., unequivocal data capture, instantaneous availability of data for analytical purposes) are apparent as well.

• Most stationary devices in the restaurant have the potential to become smart (Berezina et al., 2019; Geron, 2017). This affects signage, menus and tables in the FoH as well as kitchen appliances in the BoH. The former might be linked to the PoS systems and provide functionalities like ordering as well as entertainment while the latter might (semi)automate the preparation of food. The world of connected sensors and actuators ("Internet of Things") is already present in many kitchen devices (e.g., oven, fridge, inventory sensors in bins, thermometers, faucets) as well as in more complex robotic devices (Blöcher & Alt, 2020). These comprise smart cooking devices (e.g., sous vide, pressure cooker, kneading machine) and 3D printing for personalized food production (e.g., bakeries), but also human-like robotic arms, hands and fingers that are able to perform simple operations in the kitchen and to automate the preparation of meals and drinks.

• Social media technologies are important enablers for most customer-facing activities, such as marketing, ordering, rewarding and recommending ("Social CRM"). As indicated above, customers might not only follow the restaurant on its social web presence, but also connect to smart devices (e.g., tables) in the restaurant to interact with restaurant staff or other contacts. Linked with mass customization strategies, customers could create their own menus or dishes, share them within their network and receive rewards. Followers could then choose to adopt these menus on their next visit, enhance recipes and store or share them with others.

• Smart technologies, such as analytics, AI and XR are often present in combination with other technologies, e.g., in PoS systems and smart mobile or stationary devices. They rely on the extraction of data and unveil many use cases (Blöcher & Alt, 2020). Well-known examples are analytics for decision support (e.g., in planning staffing and inventories), learning and adaptive strategies (e.g., for personalization and forecasting) and marketing analytics (e.g., for personalized campaigns and offers). In the form of digital assistants AI enables interactive text and voice interfaces, which could be used by customers for information and ordering services as well as by staff for restaurant management or the control of smart devices.

• Finally, DLT and QC are looming on the horizon. A variety of DLT use cases has been suggested (e.g., Casino et al., 2019; Spielman, 2021), which report substantial benefits due to (almost) real-time sharing of information in distributed supply chain settings. Among the examples are to provide tamper-proof evidence on the origins of food, to track the goods while in transit and in storage as well as the documentation along the supply chain. Although many restaurants will not likely participate in such DLT solutions directly, the PoS systems could feature the required interfaces "out of the box" and thus increase the efficiency of many upstream activities. QC appears in an even more premature stage and is believed to jeopardize cryptology, which is a key technology for DLT, but also to provide momentum to many AI-based applications.

4. Implications and Conclusions

In summary, this analysis of existing digital services has shown that digital transformation has reached the restaurant industry. Despite it was based on an initial web-based survey and requires more in-depth and empirical future research, several implications may be derived. First, it should be recognized that contrary to the classical PoS systems, digital services are an option for larger and smaller restaurants alike. In particular, this broadens the digital options for smaller businesses. Second, the digital services comprise numerous offerings that support many functions in a restaurant's FoH and BoH areas. Third, four directions may be formulated that shape future strategies for restaurants:

• **More touch points.** Restaurants have the opportunity to involve customers at more touch points. Customer journeys will be hybrid (Nüesch, Alt, & Puschmann, 2015) and start earlier with pre-visit services, which call for an alignment with services during and after the restaurant visit. Ordering and payment is more often decoupled from the physical visit in the restaurant, much like dining itself, which may be decoupled with delivery services from the physical restaurant.

• **More individualization.** Data provided by customers and data collected from them will enable restaurants to interactively tailor offerings from campaigns to the meals themselves. This may comprise the ability to track ingredients to the origin, to flexibly in-/exclude ingredients, to compose individual menus and to share these configurations via social networks as well as to provide seating depending on individual preferences.

• **More automation.** In view of the numerous activities, which restaurants are still conducting manually, smart devices are expected to spread and to take over tasks in FoH as well as in BoH processes. Among the examples are automatic ordering services towards suppliers and partly for customers in- and outside of the restaurant as well as the (semi-)automatic preparation of (side) dishes with robots and other networked equipment.

• **More integration.** Even small restaurants will be able to benefit from integrated systems. Table-top devices, multi-touch tables and the integration of the customers' own devices add to interactive restaurant experiences. This need for integrating services along the entire customer journey and supply chain requires standards, but will overall favor the use of digital platforms. Obviously, it will lead to closer alignment of FoH and BoH activities.

On a more technological level, the question arises of how the various digital services may be used and how higher levels of integration may be achieved. In general, four main options may be distinguished (see Figure 2): the first is rather a starting scenario which features little integration. Here, restaurants may decide to purchase (or lease) various separate systems and implement them locally. In view of the necessary technological skills, the separate systems (e.g., a cash register connected to handhelds, a separate accounting system and a planning system for restaurant management) will remain little integrated. The second scenario denotes local integration and corresponds to the implementation of a PoS system, which offers aligned FoH and BoH functionalities. It typically enjoys a steadily growing functional scope, which comes from the software provider with each new release. As mentioned in the second chapter, this scenario requires a local technological infrastructure and technical expertise, which is likely available in larger restaurants or chains. With the rise of cloud offerings, restaurants are able to benefit from two additional scenarios, which might also be combined with the local scenarios towards hybrid local-cloud configurations. In the third case, restaurants decide to use several cloud services separately. This might be a straightforward option for many small businesses, since the desired functionalities may be purchased on demand and only need limited client hardware (e.g., a tablet or handheld devices). More advanced is the fourth scenario where the service provider has already integrated various functionalities and combines several other services on a platform as a one-stop solution (Sheresheva et al., 2020). PoS system providers might be in a good position to develop such platforms (Khatri, 2020), which possibly evolve towards ecosystems where multiple services and

devices are aligned to complement each other. The offerings of Doshii or Omnivore are pointing in this direction.

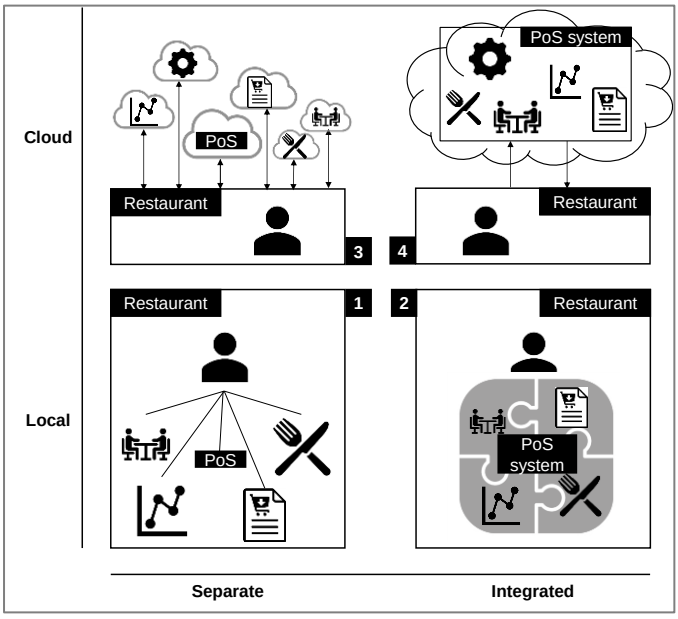

Fig. 2. Digitalization options for restaurants

As with every change, the digital transformation of the restaurant industry offers risks and opportunities. Not every innovation will be successful, which is also true for restaurants. Investments should be carefully considered since new devices involve costs and might disturb processes in case of non- or malfunctioning. An example is Zume Pizza, a California-based start-up venture that pioneered robots in pizza baking. After several problems the pizza baking business was discontinued and instead the company focused on sustainable packaging solutions (Bosa, 2020). Such ventures illustrate the general challenge with digital innovations: despite technology acts as an important enabler, the solution will not be to simply apply as much technology as possible. It is rather the mix of the entire business model, which needs to be configured convincingly. In this vein, Zysman and Kenney (2018, p. 54) asserted that "digital technology does not, in or of itself, dictate a single answer." For restaurants this means, that the broad availability of cloud services and digital devices is only a potential, which yields many opportunities. It is, however, not a guarantee for success in itself.

From a theoretical perspective this initial analysis reveals potential innovations along the restaurant value chain that comprises customer and supply chain processes. These could be helpful in establishing a reference process model as well as in deriving categorizations for digital innovations in this industry. In addition, the four strategies towards digitalization together with the digitalization options could serve to formulate and to assess industry-specific architectural archetypes. From a practical perspective the analysis highlights that during the pandemic many options for digitalizing their business (re)appeared "on the table" of restaurant managers. For a successful transformation, they demand a profound understanding of the restaurant's own core competencies, its (existing and potential) customers and its market (i.e., competitors, supply chain as well as technology partners). Restaurant managers should be aware that in a world of digital platforms and networks, their individual value proposition remains key. While larger restaurants and chains will be able to invest more in automating physical restaurant operations in the FoH and BoH areas, smaller businesses will need to assess their niche business models in view of digital services. Even if many restaurants are not in a position to hire expensive management consultants, they should scrutinize their customers' process chain as well as their supply chain processes and decide where digital services create value. In the end, the preparation of food and beverages will not become obsolete, but will have to be reassessed in the light of novel technologies. It is an opportunity to relieve restaurants from non-differentiating manual tasks and for leveraging digitalization to create an even better experience for their customers

Declaration of competing interests

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